DESIGN AND DEVELOPMENT OF AUTOMATED MATERIAL HANDLING SYSTEM

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***Abstract*— In today's ever-growing world, the industry is moving towards automation and robotic assisted systems to increase productivity and deliver uniform quality. One such type of system commonly used in industry is a robotic manipulator or simply a robotic arm. It is an open or closed kinematic chain of rigid links interconnected by movable joints using a motor and a gearbox. At end of the arm, a wrist joint connects an end effector which may be a tool and its fixture or a gripper or any other device to work. The project consists of designing an 'Automated Material Handling System' consisting of a pick and place robot and selection of its auxiliary components such as conveyor for an industrial application.**

Keywords*— *Robotic Arm, Material Handling System, Motor, Gearbox, PLC Programming.

I. INTRODUCTION

In this project, the manual process of transportation of manufactured pallets is to be replaced by an automated system comprising a Cartesian robot, conveyors and other auxiliary systems that will save power, time and labour cost as well as improve the productivity of the industry. The complete operation is controlled by a Programmable Logic Controller (PLC). In this system, the pallet is picked by a robotic arm from the gripper and placed at the conveyor and the conveyor transports it to the storage. It is used to ease the complex tasks of picking up a heavy pallet and doing them with perfection and speed. Hyland [1] studied multiple types of robot material handling systems and their orientations. Mourya et al. [2] have discussed the designing procedure to build a robot using a DC Servo Drive System for the actuation of its mechanism. Bhalerao et al. [3] have discussed and developed the control technology for their robotic arm using PLC. Munir et al. [4] have debated the use of Industrial Ethernet to connect machines anywhere in the world. A Cartesian robot with controllable arms/axes was planned referring to the literature survey.

II. PROBLEM STATEMENT

'To automate the process of transportation of injection moulded pallet right from mould to its storage.'

III. OBJECTIVES

- To reduce the cycle time for the transportation of the pallet right from removing the pallet, and placing it on the conveyor to its storage.
- To increase the safety of the worker while working on the transportation of pallets after removing them from the mould.
- To improve the overall productivity of manufacturing operations and transportation processes.

IV. DESIGN:

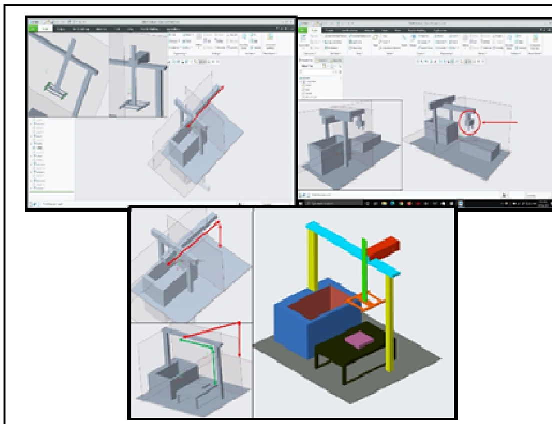


Fig (1) : Brainstormed Concepts

CONCEPT SELECTION USING PUGH MATRIX			
Criteria	Concept 1	Concept 2	Concept 3
Structural Simplicity	+	+	+
Safety	+	+	+
Power Consumption	-	+	+
Adaptability / Versatility	-	0	+
Travel Time	+	+	+
Space Optimisation	0	0	+
Sum of Positives (+)	3	4	6
Sum of Negatives (-)	2	0	0
Sum of Zeros (0)	1	2	0
Total (Net Score)	3	4	6
Rank	3	2	1
Continue	NO	NO	YES

Fig (2) : Pugh's Matrix for Concept Selection

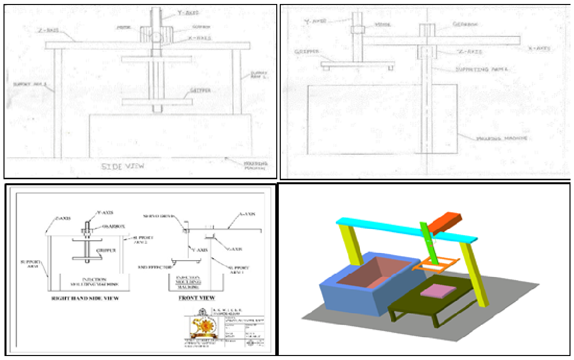


Fig (3) : Developing the selected concept

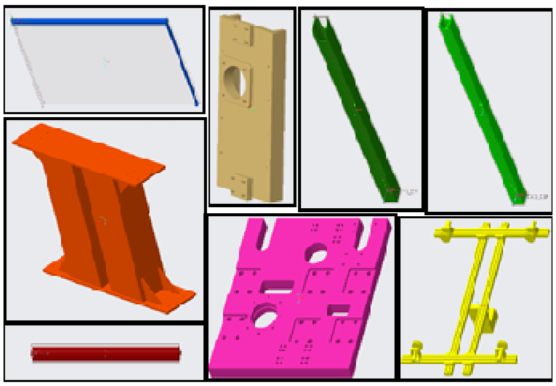


Fig (4) : 3D Models of the Components

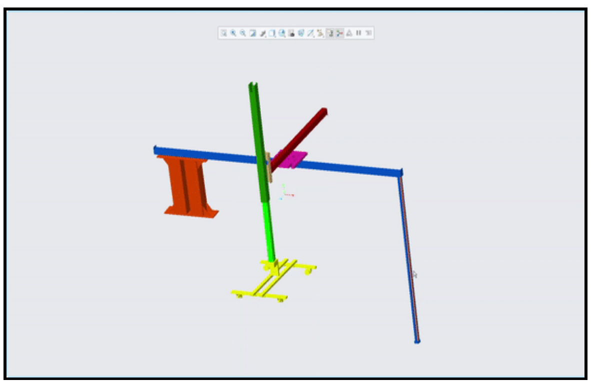


Fig (5) : 3D Model of the Assembly

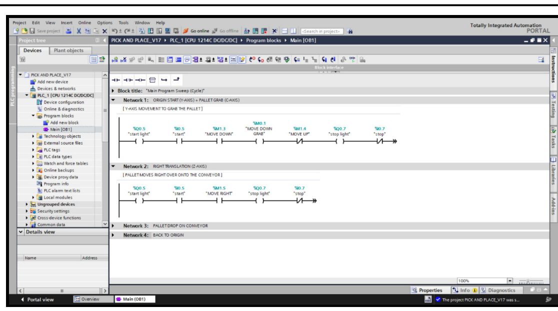


Fig (6) : Programmable Ladder Logic used for the control of the system in Siemens TIA Portal

V. SIMULATION:

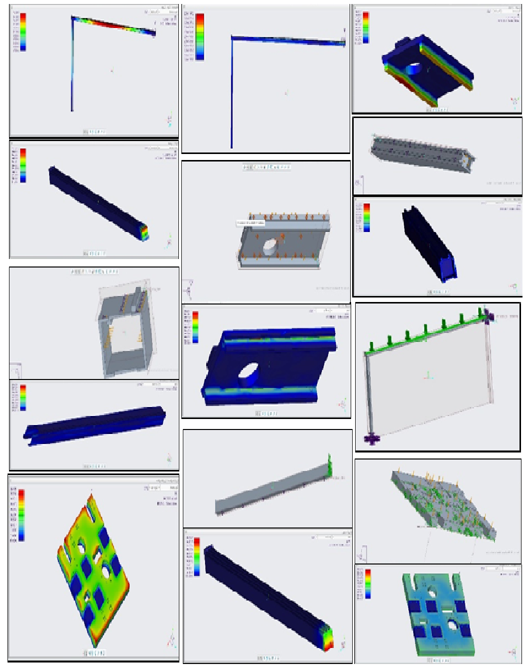


Fig (7) : Simulation of the components checking for displacement and stresses

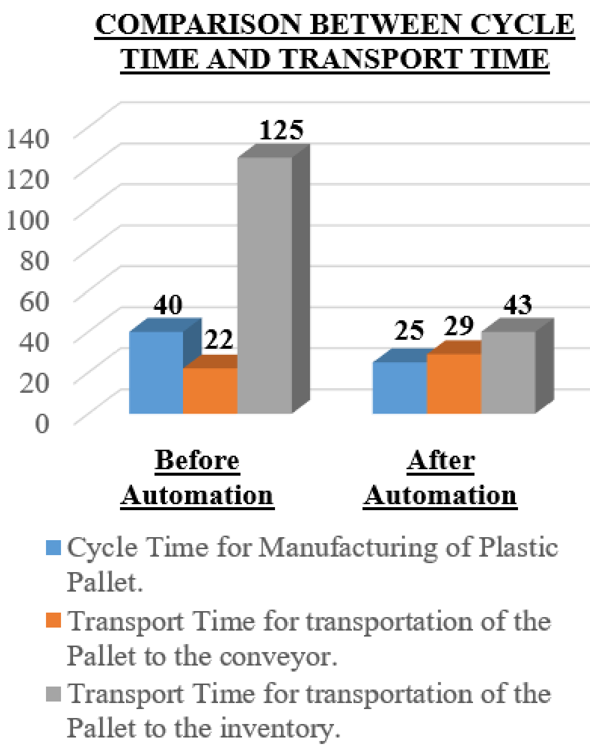
VI. PRACTICAL IMPLICATIONS / APPLICATIONS

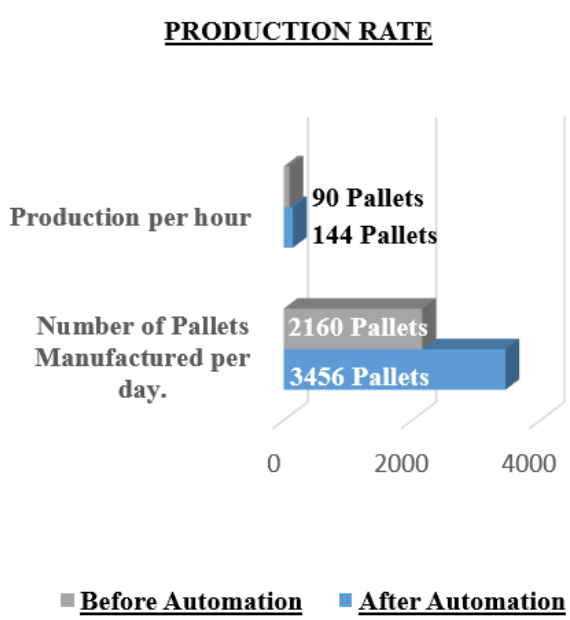
Fig (8) : Manufacturing of the system

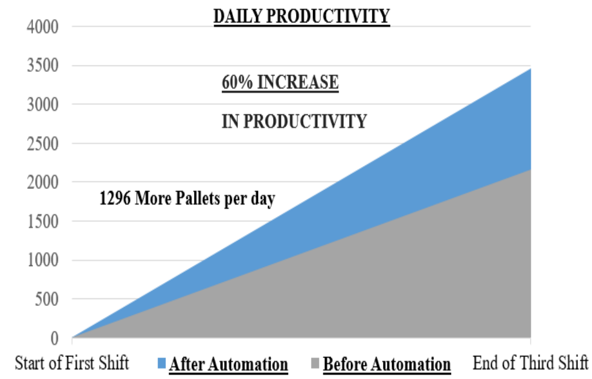
Fig (9) : Final assembly of the system

RESULTS

The results were produced based on the observations and then the analysed results are shown in a graphical vector (Bar Graph) below:







The project has led to the productivity increase of the system increased by **60%**.

CONCLUSION

The completion of the project aided in the successful achievement of the following objectives:

a) Cycle Time: The whole process that manually took more around 125 seconds to complete (from picking up the pallet in the machine to placing it on the conveyor), has been significantly reduced to merely 43 seconds. Hence saving a lot of crucial time taken to complete the process and allowing for it to be utilized elsewhere.

b) Productivity: Considering the reduction in cycle time, the productivity of the industry has been increased without any loss in quality or risk of errors.

c) Safety: Since no employee is required to perform manual labour, there is an improvement in the safety of the employees of the industry.

New, advanced technologies are developed every day, with old traditional techniques becoming obsolete. Some of the progressive technologies such as Cloud Connectivity, Advanced Vision Systems, Advanced Material, Energy Efficiency, Enhanced Safety, Thermal Sensitivity and Self-Troubleshooting can be implemented in the material handling system.

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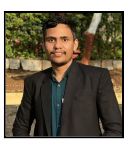

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